Pending Claims:

This listing of claims replaces all prior versions and listings of claims in the application:

Listing of Claims:

1. (Previously presented) A medium bearing a deformable model configured to enable a machine to estimate positions of four points defined by X and Y coordinates, each of the points representing a facial element position in a digital image, and compute transformation parameters that represent a transformation from the deformable model to the positions of the four points.

2. (Original) The medium bearing a deformable model of claim 1 in which the four points include a first point designating a center of a left eye.

3. (Original) The medium bearing a deformable model of claim 2 in which the four points further include a second point designating a center of a right eye.

4. (Original) The medium bearing a deformable model of claim 3 in which the four points further include a third point designating a left corner of the mouth.

5. (Original) The medium bearing a deformable model of claim 4 in which the four points further include a fourth point designating a right corner of a mouth.

6. (Original) The medium bearing a deformable model of claim 5 further comprising a variable representing a distance between the first and second points.

7. (Original) The medium bearing a deformable model of claim 6 further comprising a variable representing a distance between the third and the fourth points.

8. (Original) The medium bearing a deformable model of claim 7 further comprising a variable representing a distance between eyes and mouth.

9. (Previously presented) A method comprising:

determining a deformable model including eye positions and mouth positions for a frame of a digital image sequence; and

estimating a subsequent deformable model including eye positions and mouth positions for a subsequent frame of the digital image sequence; and

computing transformation parameters that represent a transformation from the deformable model for the frame to the subsequent deformable model of the subsequent frame.

10. (Previously presented) The method of claim 9, wherein computing the transformation parameters includes determining optimal values for the transformation parameters such that the value of an objective function based on the transformation parameters is minimized.

11. (Original) The method of claim 10 in which the eye positions and the mouth positions are represented by four points defined by X and Y coordinates.

12. (Original) The method of claim 11 in which the four points comprise a first point designating a left eye center and represented by $i = 1$.

13. (Original) The method of claim 12 in which the four points further comprise a second point designating a right eye center and represented by $i = 2$.

14. (Original) The method of claim 13 in which the four points further comprise a third point designating a left mouth corner and represented by i = 3.

15. (Original) The method of claim 14 in which the four points further comprise a fourth point designating a right mouth corner and represented by i = 4.

16. (Previously presented) The method of claim 10 in which the four points of the subsequent deformable model are determined by six parameters and the deformable model.

17. (Original) The method of claim 16 in which the six parameters comprise:

a first parameter representing a distance increase between eyes;

a second parameter representing a distance increase between eyes and mouth;

a third parameter representing a distance increase between mouth corners;

a fourth parameter representing a rotation angle;

a fifth parameter representing a shift value along an X axis; and

a sixth parameter representing a shift value along a Y axis.

18. (Previously presented) A computer program product for defining a deformable model for facial recognition, the computer program product comprising instructions stored on a computer-readable storage device that when executed, cause a data processing apparatus to:

determine a deformable model, including eye positions and mouth positions, for a frame of a video sequence;

estimate a subsequent deformable model, including eye positions and mouth positions, for a subsequent frame of the video sequence, and

compute transformation parameters that represent a transformation from the deformable model for the frame to the subsequent deformable model of the subsequent frame.

19. (Previously presented) The product of claim 18 wherein the instructions that cause the data processing apparatus to compute the transformation parameters include instructions to determine optimal values for the transformation parameters such that the value of an objective function based on the transformation parameters is minimized.

20. (Original) The product of claim 19 in which eye corner positions and mouth corner positions are represented by four points defined by X and Y coordinates.

21. (Original) The product of claim 20 in which the four points comprise a first point designating a left eye corner and represented by $i = 1$.

22. (Original) The product of claim 21 in which the four points further comprise a second point designating a right eye corner and represented by $i = 2$.

23. (Original) The product of claim 22 in which the four points further comprise a third point designating a left mouth corner and represented by $i = 3$.

24. (Original) The product of claim 23 in which the four points further comprise a fourth point designating a right mouth corner and represented by $i = 4$.

25. (Previously presented) The product of claim 20 in which the four points of the subsequent deformable model are determined, at least in part, based on six parameters.

26. (Original) The product of claim 25 in which the six parameters comprise:

a first parameter representing a distance increase between eyes;

a second parameter representing a distance increase between eyes and mouth;

a third parameter representing a distance increase between mouth corners;

a fourth parameter representing a rotation angle;

a fifth parameter representing a shift value along an X axis; and

a sixth parameter representing a shift value along a Y axis.

27. (Previously presented) A method comprising:

receiving a first digital image in a sequence of digital images and eye and mouth coordinates;

outputting eye and mouth coordinates on a subsequent digital image in the sequence of digital images; and

computing transformation parameters that represent a transformation from a base face model for the first digital image to a subsequent deformable model for the subsequent digital image.

28. (Previously presented) The method of claim 27 wherein receiving comprises estimating the base face model, denoted M_b, and the base face model's transformation parameters, denoted T', by the eye and mouth coordinates.

29. (Previously presented) The method of claim 28, wherein outputting comprises:

calculating an initial model, denoted M, for the subsequent digital image as a transformed base model M_b using the transformation parameters T'; and

rotating the subsequent image to the first digital image, denoted I(x,y), to generate a normalized model of the initial model M.

30. (Previously presented) The method of claim 29, wherein outputting further comprises:

calculating a horizontal and vertical gradient map on the rotated image; and

estimating new transformation parameters, denoted T*, by minimizing an energy function E(T,I(x,y)) representative of the goodness of fit between the transformed model and the corresponding digital image, and of the optimality of the new transformation parameters, where T* corresponds to the complex argument of the minimum of the energy function, denoted arg $\min_T$ E(T,I(x,y)).

31. (Original) The method of claim 30 in which minimizing comprises a downhill simplex method with initial transformation parameters T = T'.

32. (Original) The method of claim 30 further comprising calculating the eye centers and the mouth corners by the transformed base model using the transformation parameters T*.